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(54) Title: MULTIPLE PATIENT MONITORING SYSTEM FOR PROACTIVE HEALTH MANAGEMENT
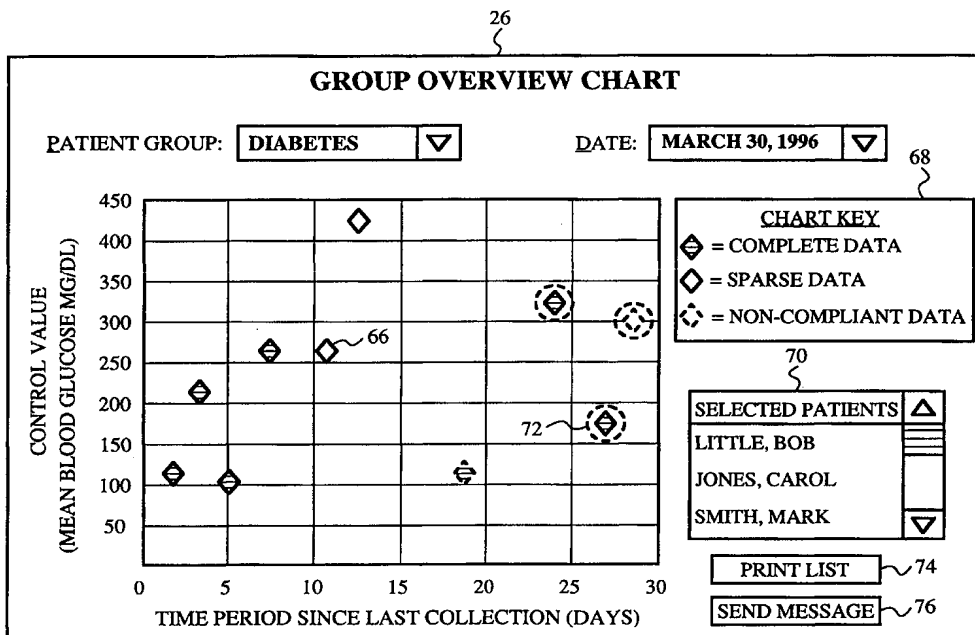
(57) Abstract

A system and method for monitoring a group of patients who have a chronic disease or ongoing health condition. The method comprises the steps of recording sets of measurements of patient's sites (200); transmitting the sets of measurements (200) to a remote database (18). Control values (206) are calculated, and the level of completeness of the measurements (210) and the compliance levels (208) are determined for each patient. Electronic messages (220) may be sent to selected patients as obtained from patient charts (218) in a display group overview chart (216).

5   **MULTIPLE PATIENT MONITORING SYSTEM FOR PROACTIVE HEALTH
                                 MANAGEMENT**

                   RELATED APPLICATION INFORMATION

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     This application claims priority from copending U.S. application
     Ser. No. 08/732,158 filed October 16, 1996 which is hereby
     incorporated by reference.

15   **TECHNICAL FIELD OF THE INVENTION**

     The present invention relates generally to computer systems for
     managing healthcare, and in particular to a system and method for
     proactively monitoring a group of patients having a chronic
20   disease or ongoing health condition.

                   BACKGROUND OF THE INVENTION

     Managing a chronic disease or ongoing health condition requires
25   the monitoring and controlling of a physical or mental parameter
     of the health condition. Examples of these control parameters
     include blood glucose in diabetes, respiratory flow in asthma,
     blood pressure in hypertension, cholesterol in cardiovascular
     disease, weight in eating disorders, T-cell or viral count in HIV,
30   and frequency or timing of episodes in mental health disorders.
     Because of the continuous nature of these health conditions, their
     corresponding parameters must be monitored and controlled on a
     regular basis by the patients themselves outside of a medical
     clinic.
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     Typically, the patients monitor and control these parameters in
     clinician assisted self-care or outpatient treatment programs.
     While these treatment programs offer significant advantages for

patients and healthcare providers, they present the assisting clinician with two problems in effectively managing the medical priorities of his or her patients. The first problem is in determining each patient's current medical status. Since the patients themselves monitor their health conditions, the clinician is often limited to learning each patient's status strictly through patient initiated events, such as an emergency visit or the delivery of the patient's latest medical data. Even with the current availability of remote monitoring devices which store and transmit medical data from a patient's home to a clinic, the clinician must still wait for medical information whose arrival depends on the patient's initiative.

As a result, the majority of the clinician's time is spent with the patients who are the most motivated and eager for a response, while the greatest medical needs remain with the unmotivated patients who do not visit the clinician or transmit their medical data. These unmotivated patients often develop urgent medical needs that could have been prevented with proper medical management. Consequently, the cost of treating their health conditions is much higher than one might expect given the sophistication of current medical monitoring devices.

The second problem is in determining which patients are having the greatest difficulty in controlling their health condition so that the clinician may focus attention on these patients. Unfortunately, most existing healthcare information systems are only designed to display medical data on an individual patient basis. Few systems have been developed that enable clinicians to view medical data for an entire group of patients simultaneously. Consequently, it is extremely difficult for a clinician to prioritize his or her time and efforts in a manner that optimizes care and minimizes costs and complications for the entire group of patients.

Several data collection systems have been developed for remote monitoring of a group of patients. For example, U.S. Patent 5,357,427 issued to Langen et al. on October 18, 1994 describes a

system for simultaneous remote monitoring of a group of high risk
patients using artificial intelligence. Each patient is provided
with a remote monitoring device, such as a blood pressure cuff or
blood glucose meter. The remote monitoring device is connected to
5   a telemedical interface box which transmits monitored data over a
telephone line to a data recording system. Data is also collected
from each patient using an artificial intelligence program that
asks the patient questions through a telephone. A computer is
connected to the recording system to display messages indicating a
10 current symptom of one of the patients.

Although Langen's system allows medical data to be collected from
a group of patients, it lacks a display mechanism for
simultaneously displaying summary data for the entire group of
15 patients. Langen's system also lacks a mechanism for indicating
which patients have been out of contact with the clinician and
therefore have an unknown current medical status. Consequently,
Langen's system is ineffective in aiding the clinician to
prioritize his or her time and efforts in managing the medical
20 priorities of the entire group of patients.

Another system designed to monitor a group of patients is
disclosed in U.S. Patent 5,331,549 issued to Crawford on July 19,
1994. Crawford's system includes a plurality of monitors for
25 monitoring the vital signs of a plurality of patients. Each
monitor provides a continuous data stream to a central server. A
supervisory screen is connected to the server to display the
current status of each patient's vital signs. The system further
provides a warning alarm signal when any patient's vital signs
30 exceed a predetermined limit.

While Crawford's system allows simultaneous viewing of the vital
sign status of each patient, it is only directed at monitoring a
group of patients who are continually connected to their monitors.
35 Crawford's overview screen lacks any mechanism for indicating
which patients have been out of contact with a clinician, since
continual contact is assumed. Further, the summary data presented
on the overview screen is limited to an indication of a normal

state or alarm state of each patient's vital signs. Consequently,
the system only allows a clinician to determine which patients are
having the greatest difficulty in controlling their health
condition when an actual emergency situation exists. Thus,
5   Crawford's system is effective as a medical alarm system, but of
little use to a clinician in managing the medical priorities of a
group of patients who are not continually monitored in a
healthcare facility.

10   **OBJECTS AND ADVANTAGES OF THE INVENTION**

In view of the above, it is an object of the present invention to
provide a multiple patient monitoring system which allows a
clinician to view and manage the medical priorities of an entire
15 group of patients. It is another object of the invention to
provide a multiple patient monitoring system which allows a
clinician to communicate proactively with unmotivated patients who
have lost contact with the clinician. A further object of the
invention is to provide a multiple patient monitoring system which
20 allows a clinician to optimize efforts and minimize costs in
managing the medical needs of the entire group of patients.

These and other objects and advantages will become more apparent
after consideration of the ensuing description and the
25 accompanying drawings.

SUMMARY OF THE INVENTION

The invention presents a system and method for monitoring a group
30 of patients who have a chronic disease or ongoing health
condition. The method includes the step of collecting from each
patient at least one corresponding set of measurements of a
control parameter of the health condition. Each set of
measurements has a corresponding collection date. For each
35 patient, a control value is then calculated from the patient's
corresponding set of measurements. The control value indicates
the patient's control over the health condition and is preferably
a mean value of the patient's measurements.

The method also includes the step of determining for each patient
a time period which has elapsed since the collection date of the
set of measurements most recently collected from the patient. The
5   method further includes the steps of generating and displaying an
overview chart having a plurality of data points. Each of the
data points represents a respective one of the patients and
indicates the control value and the time period determined for the
patient. In a preferred embodiment, the method includes the
10 additional steps of selecting from the chart at least one of the
patients represented thereon and automatically transmitting
supervisory instructions to the selected patient. In one
embodiment, the supervisory instructions are transmitted in an
electronic mail message. In another embodiment, the supervisory
15 instructions are transmitted in an automated telephone message.

A preferred system for implementing the method of the invention
includes a plurality of recording devices, such as monitoring
devices or electronic logbooks, for recording the sets of
20 measurements. The system also includes a server which is
networked to the recording devices. The server includes a patient
database for receiving and storing each set of measurements with
its corresponding collection date. The server also includes a
software application for generating the overview chart from the
25 collected measurements. A display is connected to the server for
displaying the overview chart to a clinician.

BRIEF DESCRIPTION OF THE DRAWINGS

30 FIG. 1   is a schematic block diagram of a multiple patient
monitoring system according to a preferred embodiment
of the invention.
FIG. 2   is a schematic block diagram illustrating the data
collected from each patient according to the preferred
35   embodiment of the invention.
FIG. 3   is a sample group overview chart according to the
preferred embodiment of the invention.

FIGS. 4-5   are sample electronic mail messages containing
             supervisory instructions for a patient.
FIG. 6   is a flow chart illustrating steps included in a
             preferred method of the invention.
5   FIG. 7   is a schematic block diagram of another multiple
             patient monitoring system according to a second
             embodiment of the invention.
FIG. 8   is a sample telephone message containing supervisory
             instructions for a patient.

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DETAILED DESCRIPTION

FIGS. 1 - 6 illustrate a preferred embodiment of the invention.
FIG. 1 shows the main components of a system for monitoring a
15   group of patients having a chronic disease or ongoing health
condition. A healthcare clinic **10** has a clinic server **12** that
includes a mail merge application **14**, a mail server application
16, a patient database **18**, and an overview application **20**.   It
will be apparent to one skilled in the art that clinic server **12**
20   may comprise a single stand-alone computer or multiple computers
distributed throughout a network.

Mail merge application **14** is designed to generate electronic mail
messages containing supervisory instructions for patients, as will
25   be explained in the operation section below. Mail server
application **16** is a standard electronic mail server for
transmitting the messages to the patients. Database **18** stores
data relating to each patient managed by clinic **10**. Overview
application **20** is a software application for performing various
30   calculations using the data stored in database **18** and for
generating an overview chart **26** from the data, as will be
explained in detail below. Server **12** is coupled to a modem **M1**
which connects server **12** to a communication network **34**. Network
34 is preferably a public telephone network, the Internet, or a
35   similar data transmission network.

A clinician workstation **22** is networked to clinic server **12**.
Workstation **22** is preferably a personal computer or network

terminal. Workstation **22** has a display **24** for displaying overview chart **26** to a clinician **30**. Workstation **22** further includes a user selection device **28**, such as a mouse or keyboard. Selection device **28** is used by clinician **30** to select the patients

5   represented on chart **26** who are to receive supervisory instructions.

A patient unit **38** is located at a first patient site **36**, typically the patient's home. Patient unit **38** displays electronic mail

10   messages which are received from mail server **16**. In the preferred embodiment, patient unit **38** is a personal computer having a display monitor. However, in alternative embodiments, patient unit **38** may be any information processing and display unit, such as a network terminal, a television set with a set-top

15   converter box, a personal digital assistant, or a video game system. Patient unit **38** includes a message display **40** for displaying the electronic mail messages. Patient unit **38** is connected to communication network **34** via a modem **M2**.

20   A recording device, such as a medical monitoring device **42**, is also connected to communication network **34** via modem **M2**. Monitoring device **42** is for collecting from a first patient **44** a set of measurements of a control parameter of the patient's health condition. The specific type of monitoring device provided to

25   each patient is dependent upon the patient's disease and its corresponding control parameter. For example, diabetes patients are provided with blood glucose meters for measuring blood glucose concentrations, asthma patients are provided with respiratory flow meters for measuring peak flow rates, obesity patients are

30   provided with weight scales, etc. Monitoring device **42** is capable of recording each measurement in the set with a corresponding measurement date and measurement time. Device **42** is also capable of transmitting the measurements to database **18** through communication network **34**. Such monitoring devices for recording

35   and transmitting measurements are well known in the art.

A second patient site **46** includes the same equipment as first patient site **36**, with the exception of the recording device used

by a second patient **49**. The recording device at second patient
site **46** is an electronic logbook **48** for recording a set of
measurements entered by the second patient. Logbook **48** is capable
of recording each measurement with a corresponding measurement

5   date and measurement time. Logbook **48** is designed to transmit the
recorded set of measurements to database **18** through communication
network **34**. Such electronic logbooks for recording and
transmitting data are well known in the art. The use of logbook
48 to record and transmit measurements enables those patients with

10 mental health conditions or other condition whose control
parameters may not be physically measured to participate in the
monitoring system.

For simplicity of illustration, only two patient sites and two

15 corresponding patients are shown in FIG. 1. It is obvious that
the system of the invention may be effectively used to monitor any
number of patients. In a typical implementation, hundreds of
patient sites are connected to clinic server **12** via communication
network **34**.

20
FIG. 2 is a schematic block diagram illustrating the data which is
collected from each patient and stored in database **18**. The data
includes at least one set of measurements **52** of a control
parameter of the health condition. Each measurement includes a

25 control parameter value **54**, such as a blood glucose concentration
for a diabetes patient, a peak flow rate for an asthma patient, or
a blood pressure reading for a hypertension patient. Each
measurement also includes a measurement date **56** and a measurement
time **58**.

30
The actual number of measurements in each set varies in dependence
upon the nature of the health condition being monitored and the
duration of time over which the measurements are recorded. For
example, diabetes patients typically measure their blood glucose

35 several times per day, so that these patients preferably record
twenty to forty measurements in a typical week of monitoring.
However, hypertension patients may only be required to measure

their blood pressure once a week, so that these patients would
record only one measurement in a typical week of monitoring.

Each set of measurements is stored in database **18** with a
5   corresponding collection date **64**.   In the preferred embodiment,
collection date **64** is the date the set of measurements is received
by database **18**.   In an alternative embodiment, collection date **64**
is the date the set of measurements is transmitted to the
database.   In another embodiment, collection date **64** is the
10   measurement date **56** of the most recent measurement in the set.   In
addition to storing the measurements, database **18** stores
information **62** relating to each patient participating in the
monitoring system.   In the preferred embodiment, the information
includes each patient's name, telephone number, and electronic
15   mail address.

Referring again to FIG. 1, software application **20** is designed to
perform various functions using the data stored in database **18**.
First, application **20** is designed to calculate a control value for
20   each patient from the patient's corresponding set of measurements.
The control value is calculated to give a clear indication of the
patient's control over the health condition.

In the preferred embodiment, the control value calculated for each
25   patient is simply the mean value of the measurements recorded by
the patient over a preselected period of time.   In an alternative
embodiment, the control value is the mean value of the set of
measurements most recently collected from the patient.   The period
of time used to calculate the control value varies in dependence
30   upon the nature of the patient's health condition.   For example, a
useful period of time for calculating a mean blood glucose value
for diabetes patients is typically one week, while a useful period
of time for calculating a mean daily number of panic attacks for
phobic patients is typically two weeks.   The period of time used
35   to calculate the control value is preferably selected by the
clinician.

Second, software application **20** is designed to determine for each
patient a time period which has elapsed since the collection date
of the set of measurements most recently collected from the
patient. For example, if a patient has only transmitted one set
5   of measurements to the database, application **20** determines the
time period that has elapsed since the collection date of the one
set. If a patient has transmitted multiple sets of measurements
to the database, application **20** determines the time period that
has elapsed since the most recent collection date.

10

Third, application **20** is designed to determine the compliance of
each patient with a prescribed measurement regimen. The
prescribed measurement regimen preferably includes prescribed
measurement dates and prescribed measurement times. To determine
15   the compliance of each patient, application **20** compares each
patient's actual measurement dates and times with the prescribed
measurement dates and times. For example, it is usually important
that a diabetes patient measure his or her blood glucose every
morning before breakfast. Thus, one prescribed measurement time
20   for a diabetes patient is 7 am, or similar pre-breakfast time.
Application **20** compares the patient's actual measurement times
with the prescribed pre-breakfast time to ensure that the patient
is complying with the measurement regimen. Of course, any desired
measurement time may be prescribed by the clinician.

25

The prescribed measurement regimen also preferably specifies the
number of measurements to be taken by the patient in a
predetermined period of time. Application **20** is further capable
of determining a completeness of each set of measurements relative
30   to the prescribed measurement regimen. For example, a typical
diabetes regimen requires three blood glucose measurements per
day. In this example, application **20** compares the actual number
of measurements recorded by the patient on each measurement date
to the three prescribed measurements to determine the completeness
35   of the set.

Software application **20** is also designed to generate overview
chart **26**. FIG. 3. illustrates a sample overview chart generated

for a group of ten diabetes patients. Chart **26** has ten data
points, with each data point representing a respective one of the
patients and indicating the control value calculated for the
patient and the time period elapsed since the patient's most
5   recent collection date. Thus, by viewing chart **26**, the clinician
immediately sees which patients have been out of contact with the
clinic and therefore have an unknown status and which patients are
having the most difficulty controlling their illness and require
special attention.

10

In the preferred embodiment, each data point is displayed on chart
26 as a respective icon **66**. Each icon indicates the compliance of
the patient with the prescribed measurement regimen. A chart key
68 is provided to explain the significance of each icon's
15   appearance. Non-compliant patients are represented by flashing
icons, while compliant patients are represented by non-flashing
icons. In FIG. 3, the flashing icons having dotted borders, while
the non-flashing icons have solid borders. Alternatively, non-
compliant patients may be represented by icons having a first
20   color, while compliant patients are represented by icons having a
second color. Each icon also indicates the completeness of the
set of measurements most recently collected from the patient.
Patients having complete sets are represented by filled icons,
while patients having sparse sets are represented by blank icons.
25   Of course, in alternative embodiments, the visual appearance of
each icon may be varied in different ways to indicate the
completeness of each patient's measurements.

Chart **26** further includes a list box **70**, a PRINT LIST button **74**,
30   and a SEND MESSAGE button **76**. List box **70** lists the names of the
patients who have been selected from chart **26** by the clinician.
The icons representing the selected patients are highlighted, as
shown by dotted circles **72**. PRINT LIST button **74** is pressed to
send the list of names to a printer (not shown) to obtain a print
35   out of the list. SEND MESSAGE button **76** is pressed to transmit
the list of names to mail merge application **14**. Specific
techniques for writing and implementing a software application to

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perform the functions described will be apparent to one skilled in
the art.

Mail merge application **14** is designed to generate customized
5   electronic mail messages containing supervisory instructions for
the selected patients. FIGS. 4 - 5 show sample electronic mail
messages **78** and **80**. Mail merge application **14** is capable of
customizing each message to include the patient's name, the
patient's electronic mail address, and the collection date of the
10 patient's most recent set of measurements. The programming of a
mail merge application to generate customized messages in this
manner is well known in the art.

The operation of the preferred embodiment is shown in FIGS. 1 - 6.
15 FIG. 6 is a flow chart illustrating a preferred method of using
the system to monitor a group of patients having a health
condition. Each patient is provided with a recording device, such
as monitoring device **42** or electronic logbook **48**. In step **200**,
each patient records in his or her recording device at least one
20 set of measurements **52** of a control parameter of the health
condition. In step **202**, the sets of measurements are transmitted
from each recording device to database **18** through communication
network **34**. In step **204**, each set of measurements is stored in
database **18** with its corresponding collection date **64**.
25
In step **206**, software application **20** calculates a control value
for each patient from the collected measurements. In step **208**,
application **20** determines each patient's compliance with the
prescribed measurement regimen by comparing the patient's actual
30 measurement times to the measurement times prescribed by the
clinician. In step **210**, application **20** determines if the set of
measurements most recently collected from each patient is complete
relative to the prescribed measurement regimen. In step **212**,
application **20** determines for each patient the time period which
35 has elapsed since the collection date of the patient's most recent
set of measurements.

In step **214**, application **20** generates overview chart **26**. In step
216, chart **26** is displayed to the clinician on workstation **22**.
As shown in FIG. 3, each data point on chart **26** is displayed as an
icon. Each icon represents a respective one of the patients and
5   indicates the control value and the elapsed time period determined
for the patient. Each icon also indicates the patient's
compliance with the prescribed measurement regimen and the
completeness of the set of measurements most recently collected
from the patient. Thus, chart **26** allows the clinician to
10 determine which patients have been out of contact with the clinic,
which patients are having difficulty controlling their disease,
and which patients are having difficulty complying with the
prescribed measurement regimen.

15 In step **218**, the clinician uses selection device **28** to select from
chart **26** the patients who are to receive supervisory instructions.
Typically, selection device **28** is a mouse or similar pointing
device, and the clinician selects the patients by clicking the
appropriate icons. As the clinician selects the patients, their
20 names are displayed in list box **70**. Next, the clinician presses
SEND MESSAGE button **76** to transmit the list of selected patients
to mail merge application **14**.

Mail merge application **14** generates a customized electronic mail
25 message for each patient selected by the clinician. Mail merge
application **14** customizes each message to include the patient's
name, electronic mail address, and the collection date of the
patient's most recent set of measurements. In step **220**, mail
server application **16** transmits the messages to the patients
30 through communication network **34**. When the patients receive the
supervisory instructions, they continue the monitoring loop with
the clinician by returning to step **200** and repeating the method
described.

35 One advantage of the monitoring system of the present invention is
that it allows the clinician to view and manage the medical
priorities of an entire group of patients simultaneously. It also
allows the clinician to communicate proactively with unmotivated

patients who have lost contact with the clinician before they
develop urgent medical needs. Consequently, the system allows the
clinician to optimize efforts and minimize costs in managing the
care of the entire group of patients.

5

A second embodiment of the invention is shown in FIGS. 7 - 8. The
second embodiment differs from the preferred embodiment in the
method of transmitting supervisory instructions to the selected
patients. According to the second embodiment, clinic server **12**
10   includes an automated telephone call processing application **82** in
place of mail merge application **14** and mail server application **16**.
Call processing application **82** is designed to generate automated
telephone messages containing supervisory instructions for the
selected patients.

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FIG. 8 illustrates a sample automated telephone message **88**.
Application **82** is capable of customizing each message to include
the patient's name and the collection date of the patient's most
recent set of measurements. The programming of an automated call
20   processing application to generate customized messages in this
manner is well known in the art. Referring again to FIG. 7,
clinic server **12** is connected to a telephone network **84** through a
digital/tone signal converter **D1**. Each patient is provided with a
dual tone multi-frequency (DTMF) telephone **86**. Each telephone is
25   connected to telephone network **84** to receive automated telephone
messages from clinic server **12**.

The operation of the second embodiment differs from the operation
of the preferred embodiment in that supervisory instructions are
30   transmitted to the selected patients in automated telephone
messages rather than in electronic mail messages. Otherwise, the
operation and advantages of the second embodiment are analogous to
those of the preferred embodiment described above.

35   **SUMMARY, RAMIFICATIONS, AND SCOPE**

Although the above description contains many specificities, these
should not be construed as limitations on the scope of the

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invention but merely as illustrations of some of the presently
preferred embodiments. Many other embodiments of the invention
are possible. For example, the patient database and software
applications may be installed on the clinician's workstation, and
5   the clinic server may be eliminated. The clinic server is
presently preferred for performing resource intensive operations,
such as storing and manipulating large amounts of patient data,
but the clinic server is not necessary to enable the system and
method of the invention. In embodiments that include the clinic
10   server, the server need not be physically located at the clinic.
The server may be located off-site and networked to the clinician
workstation.

Moreover, the preferred embodiment describes the use of monitoring
15   devices and electronic logbooks for collecting data from each
patient. However, many other methods of collecting data from the
patients are possible. For example, the patients may be provided
with paper based logbooks and automated readers for digitizing and
transmitting the logbook information to the database.
20   Alternatively, patients may mail or fax the logbook information to
the clinic for entry into the database. In another embodiment,
the patients use DTMF telephones to connect to the database and
enter their data through the telephone keypads.

25   Further, the electronic mail messages and automated telephone
messages illustrated are exemplary of the preferred embodiment.
Many other messages may be generated and transmitted to patients
in alternative embodiments. Additionally, the preferred
embodiment describes a system and method for monitoring patients
30   having diabetes. However, the invention is not limited to
monitoring diabetes patients. The system and method are equally
effective for managing patients who have asthma, hypertension,
cardiovascular disease, eating disorders, HIV, mental health
disorders, or any other health condition having a measurable
35   control parameter.

Therefore, the scope of the invention should be determined not by the examples given but by the appended claims and their legal equivalents.

CLAIMS

What is claimed is:

1   1. A method for monitoring a group of patients having a health
2   condition, the method comprising the computer implemented
3   steps of:
4   a) collecting from each of the patients at least one
5   corresponding set of measurements of a control parameter of
6   the health condition, wherein each of the sets has a
7   corresponding collection date;
8   b) for each of the patients, calculating from the
9   corresponding set of measurements a control value
10   indicating the patient's control over the health condition;
11   c) for each of the patients, determining a time period which
12   has elapsed since the collection date of the set of
13   measurements most recently collected from the patient; and
14   d) generating and displaying a chart having a plurality of
15   data points, wherein each of the data points represents a
16   respective one of the patients and indicates the control
17   value and the time period determined for the patient.
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1   2. The method of claim 1, further comprising the steps of
2   selecting from the chart at least one of the patients
3   represented thereon and automatically transmitting
4   supervisory instructions to the selected patient.
5

1   3. The method of claim 2, wherein the instructions are
2   transmitted in an electronic mail message.
3

1   4. The method of claim 2, wherein the instructions are
2   transmitted in a telephone message.
3

1   5. The method of claim 1, further comprising the steps of
2   determining a compliance of each of the patients with a
3   prescribed measurement regimen and indicating the
4   compliance on the chart.
5

6. The method of claim 5, wherein each of the data points
    is displayed on the chart as a respective icon whose
    appearance indicates the compliance of the represented
    patient.

7. The method of claim 1, further comprising the steps of
    determining a completeness of each of the sets of
    measurements relative to a prescribed measurement regimen
    and indicating the completeness on the chart.

8. The method of claim 7, wherein each of the data points
    is displayed on the chart as a respective icon whose
    appearance indicates the completeness of the set of
    measurements collected from the represented patient.

9. The method of claim 1, wherein the control value calculated
    for each of the patients comprises a mean value of the set
    of measurements collected from the patient.

10. A system for monitoring a group of patients having a health
    condition, the system comprising:
    a) a collection means for collecting from each of the patients
        at least one corresponding set of measurements of a control
        parameter of the health condition, wherein each of the sets
        has a corresponding collection date;
    b) a processor means connected to the collection means for
        determining for each of the patients:
        i) a control value indicating the patient's control over
            the health condition, the control value being
            calculated from the patient's corresponding set of
            measurements; and
        ii) a time period which has elapsed since the collection
            date of the set of measurements most recently collected
            from the patient;
        wherein the processor means further includes means for
        generating a chart having a plurality of data points, and
        wherein each of the data points represents a respective one

19   of the patients and indicates the control value and the
20   time period determined for the patient; and
21 c) a display means connected to the processor means for
22   displaying the chart.
23

1   11. The system of claim 10, further comprising:
2   a) selection means connected to the processor means for
3   selecting from the chart at least one of the patients
4   represented thereon; and
5   b) automated response means connected to the processor
6   means for transmitting supervisory instructions to the
7   selected patient.
8

1   12. The system of claim 11, wherein the automated response
2   means comprises electronic mail means for transmitting
3   the instructions in an electronic mail message.
4

1   13. The system of claim 11, wherein the automated response
2   means comprises call processing means for transmitting
3   the instructions in a telephone message.
4

1   14. The system of claim 10, wherein the processor means further
2   includes means for determining a compliance of each of the
3   patients with a prescribed measurement regimen and means
4   for visually indicating the compliance on the chart.
5

1   15. The system of claim 14, wherein each of the data points
2   is displayed on the chart as a respective icon whose
3   appearance indicates the compliance of the represented
4   patient.
5

1   16. The system of claim 10, wherein the processor means further
2   includes means for determining a completeness of each of
3   the sets of measurements relative to a prescribed
4   measurement regimen and means for visually indicating the
5   completeness on the chart.
6

1   17. The system of claim 16, wherein each of the data points
2   is displayed on the chart as a respective icon whose
3   appearance indicates the completeness of the set of
4   measurements collected from the represented patient.
5

1   18. The system of claim 10, wherein the control value
2   calculated for each of the patients comprises a mean value
3   of the set of measurements collected from the patient.
4

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10

CLINIC

12

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SERVER

14 — MAIL MERGE
APPLICATION

16 — MAIL SERVER
APPLICATION

18 — PATIENT
DATABASE

20 — OVERVIEW
APPLICATION

CLINICIAN
WORKSTATION

DISPLAY   24

GROUP
OVERVIEW
CHART   26

SELECTION DEVICE   28

CLINICIAN   30

MODEM   M1

COMMUNICATION NETWORK   34

M2   MODEM

38 — PATIENT
UNIT

40 — MESSAGE
DISPLAY

42 — MONITORING
DEVICE

44 — PATIENT 1

PATIENT SITE 1

36

MODEM

PATIENT
UNIT

MESSAGE
DISPLAY

48 — ELECTRONIC
LOGBOOK

49 — PATIENT 2

PATIENT SITE 2

46

FIG. 1

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```
┌──────────────────────────────────────────────────────────────────┐
│              DATA COLLECTED FROM EACH PATIENT                       │
│   ┌────────────────────────────────────────────────────────────┐  │
│   │                  SET OF MEASUREMENTS                         │  │
│   │  ┌──────────────────────────┐      ┌──────────────────────┐ │  │
│   │  │       MEASUREMENT 1      │      │    MEASUREMENT N      │ │  │
│   │  │  ┌────────────────────┐  │      │  ┌────────────────┐  │ │  │
│   │  │  │  PARAMETER VALUE   │  │      │  │ PARAMETER VALUE │  │ │  │
│   │  │  ├────────────────────┤  │ ● ● ●│  ├────────────────┤  │ │  │
│   │  │  │  MEASUREMENT DATE  │  │      │  │ MEASUREMENT DATE│  │ │  │
│   │  │  ├────────────────────┤  │      │  ├────────────────┤  │ │  │
│   │  │  │  MEASUREMENT TIME  │  │      │  │ MEASUREMENT TIME│  │ │  │
│   │  │  └────────────────────┘  │      │  └────────────────┘  │ │  │
│   │  └──────────────────────────┘      └──────────────────────┘ │  │
│   └────────────────────────────────────────────────────────────┘  │
└──────────────────────────────────────────────────────────────────┘
```

52, 54, 56, 58

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```
┌──────────────────────────────────────────────────────────────────┐
│                     PATIENT DATABASE                               │
│  ┌──────────────────────────────────┐   ┌──────────────────────┐  │
│  │        PATIENT 1 RECORDS         │   │      PATIENT N       │  │
│  │  ┌────────────────────────────┐  │   │      RECORDS         │  │
│  │  │    PATIENT INFORMATION     │  │   │  ┌────────────────┐  │  │
│  │  └────────────────────────────┘  │   │  │    PATIENT      │  │  │
│  │  ┌────────────────────────────┐  │   │  │  INFORMATION    │  │  │
│  │  │          SET 1             │  │   │  └────────────────┘  │  │
│  │  │  ┌──────────────────────┐  │  │   │                      │  │
│  │  │  │    MEASUREMENTS      │  │  │   │  ┌────────────────┐  │  │
│  │  │  ├──────────────────────┤  │  │   │  │     SET 1       │  │  │
│  │  │  │   COLLECTION DATE    │  │  │   │  └────────────────┘  │  │
│  │  │  └──────────────────────┘  │  │   │  ┌────────────────┐  │  │
│  │  └────────────────────────────┘  │ ● │  │     SET 2       │  │  │
│  │  ┌────────────────────────────┐  │ ● │  └────────────────┘  │  │
│  │  │          SET 2             │  │ ● │          ●           │  │
│  │  └────────────────────────────┘  │   │          ●           │  │
│  │              ●                    │   │          ●           │  │
│  │              ●                    │   │  ┌────────────────┐  │  │
│  │              ●                    │   │  │     SET N       │  │  │
│  │  ┌────────────────────────────┐  │   │  └────────────────┘  │  │
│  │  │          SET N             │  │   │                      │  │
│  │  └────────────────────────────┘  │   └──────────────────────┘  │
│  └──────────────────────────────────┘                             │
└──────────────────────────────────────────────────────────────────┘
```

62, 52, 64

FIG. 2

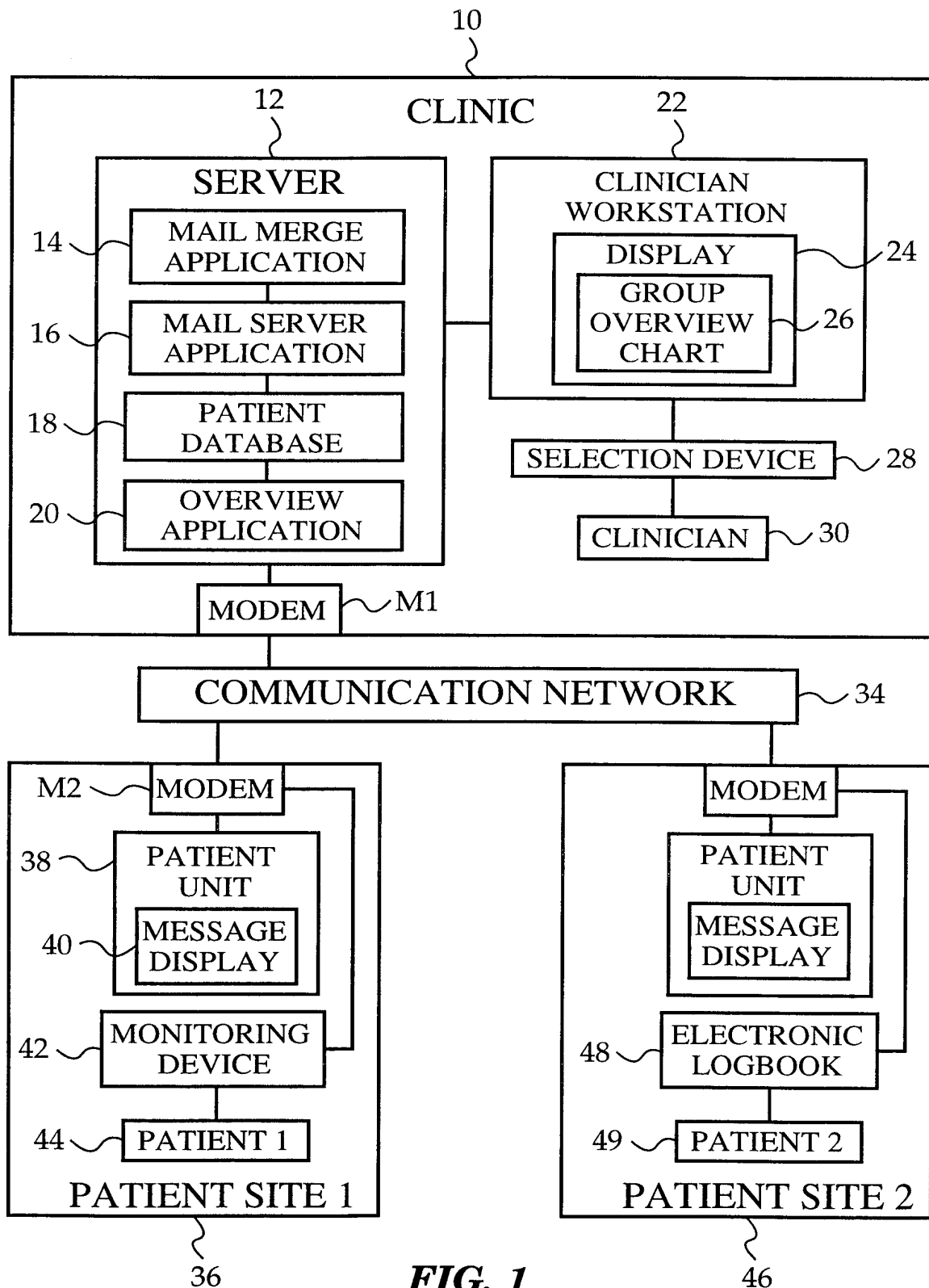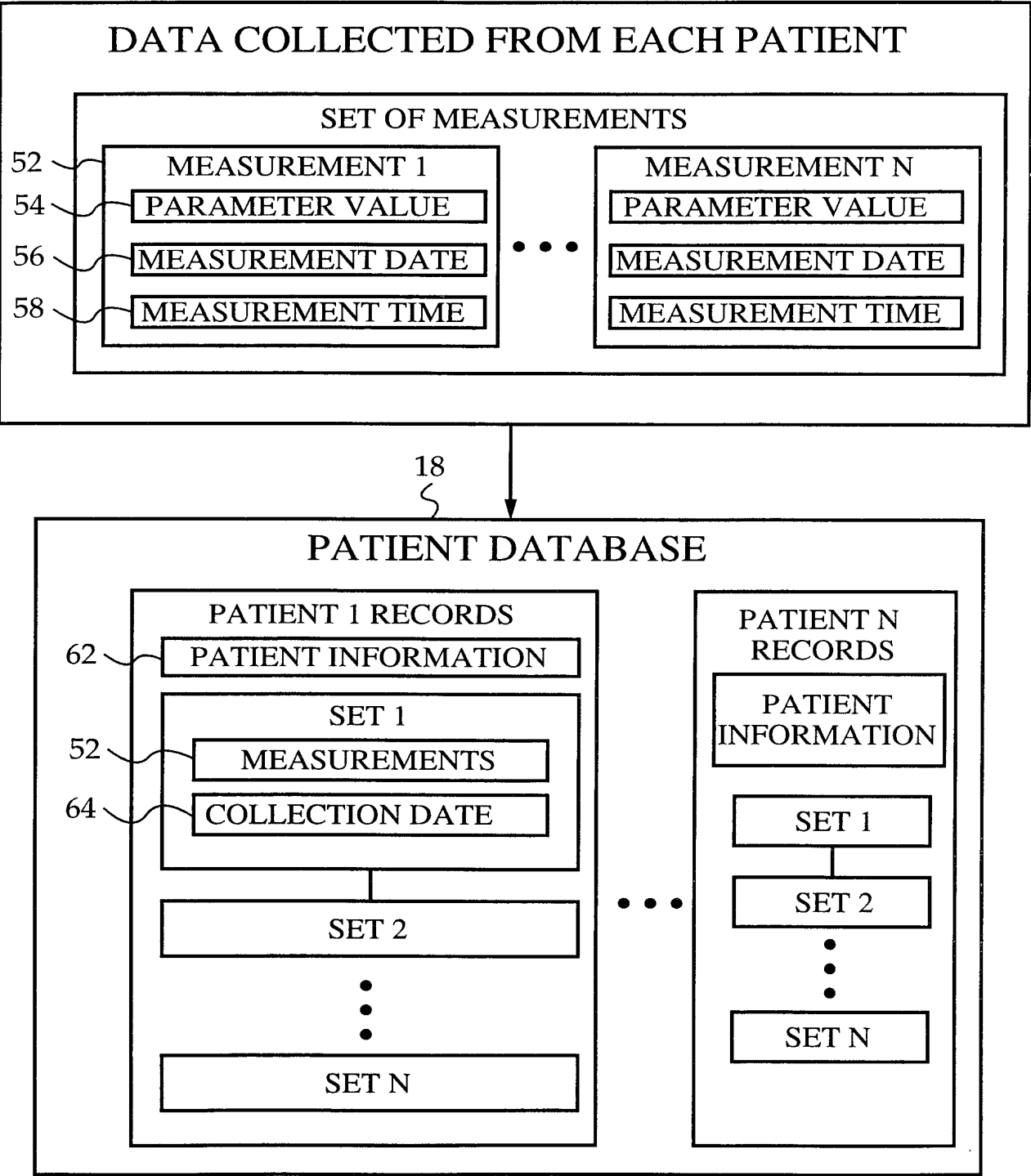FIG. 3

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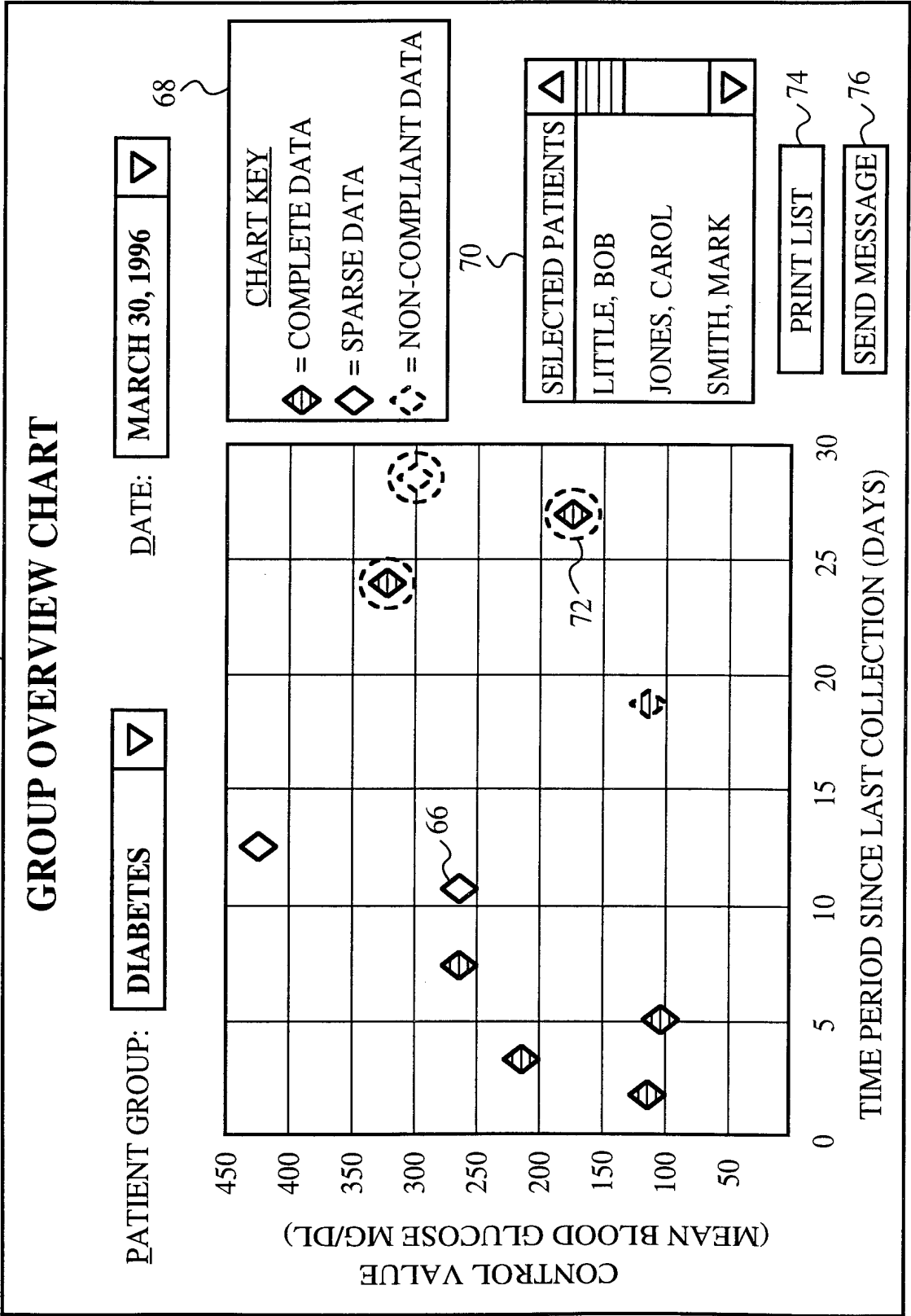| TO:	<< INSERT PATIENT MAIL ADDRESS >>
SUBJECT:	REQUEST FOR BLOOD GLUCOSE MEASUREMENTS

Hello << INSERT PATIENT NAME >>,

I have not received your blood glucose measurements since << INSERT COLLECTION DATE >> and I am concerned that your blood glucose level stay in control. Please transmit your latest measurements to the clinic today.

Sincerely,

Dr. Peters

FIG. 4

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TO:	<< INSERT PATIENT MAIL ADDRESS >>
SUBJECT:	MEASURE YOUR BLOOD GLUCOSE REGULARLY

Hello << INSERT PATIENT NAME >>,

Your last set of blood glucose measurements did not include an adequate number of measurements to assess your progress in controlling diabetes. Please remember to test your blood glucose regularly so that we may work together to keep your diabetes in control.
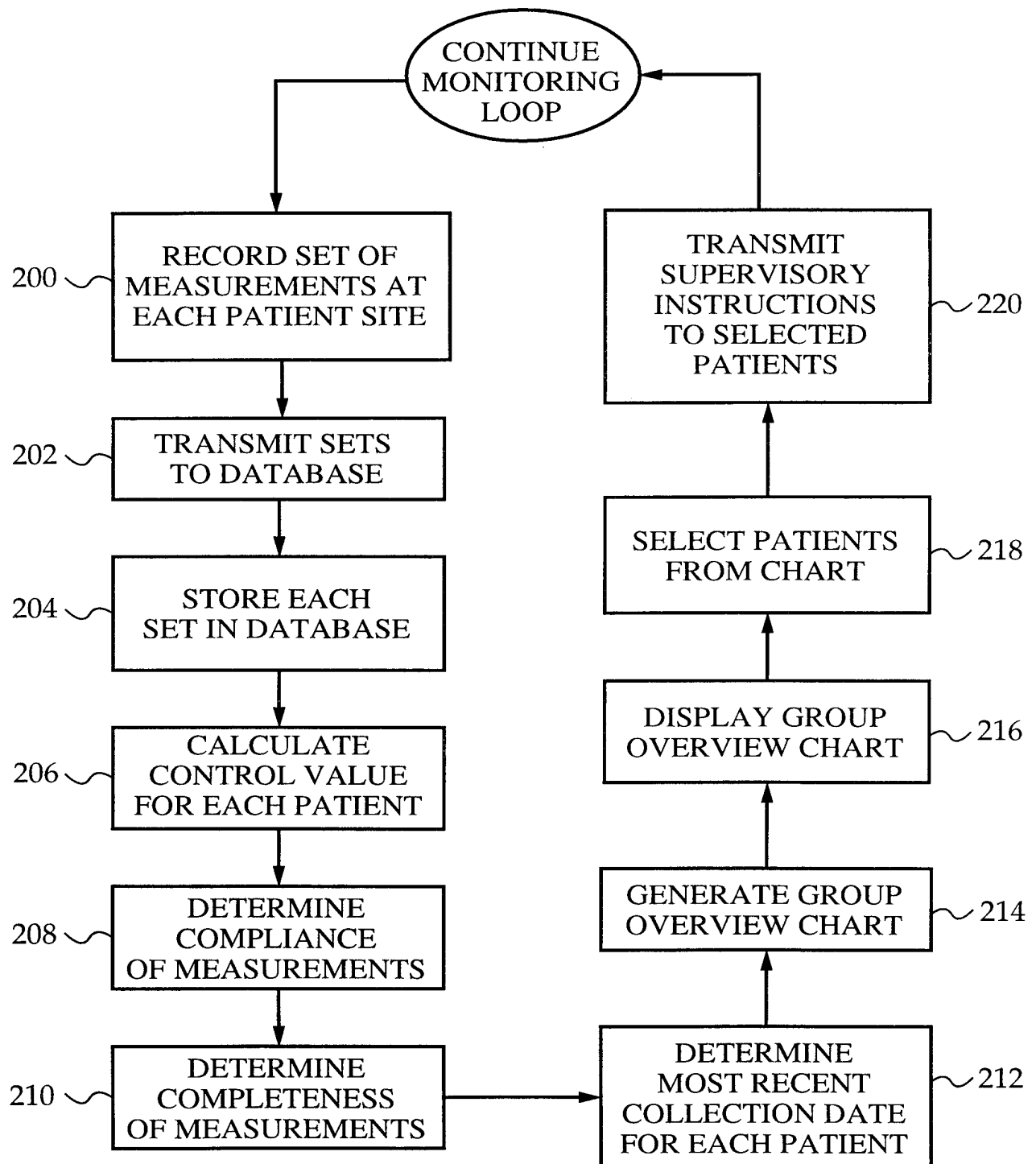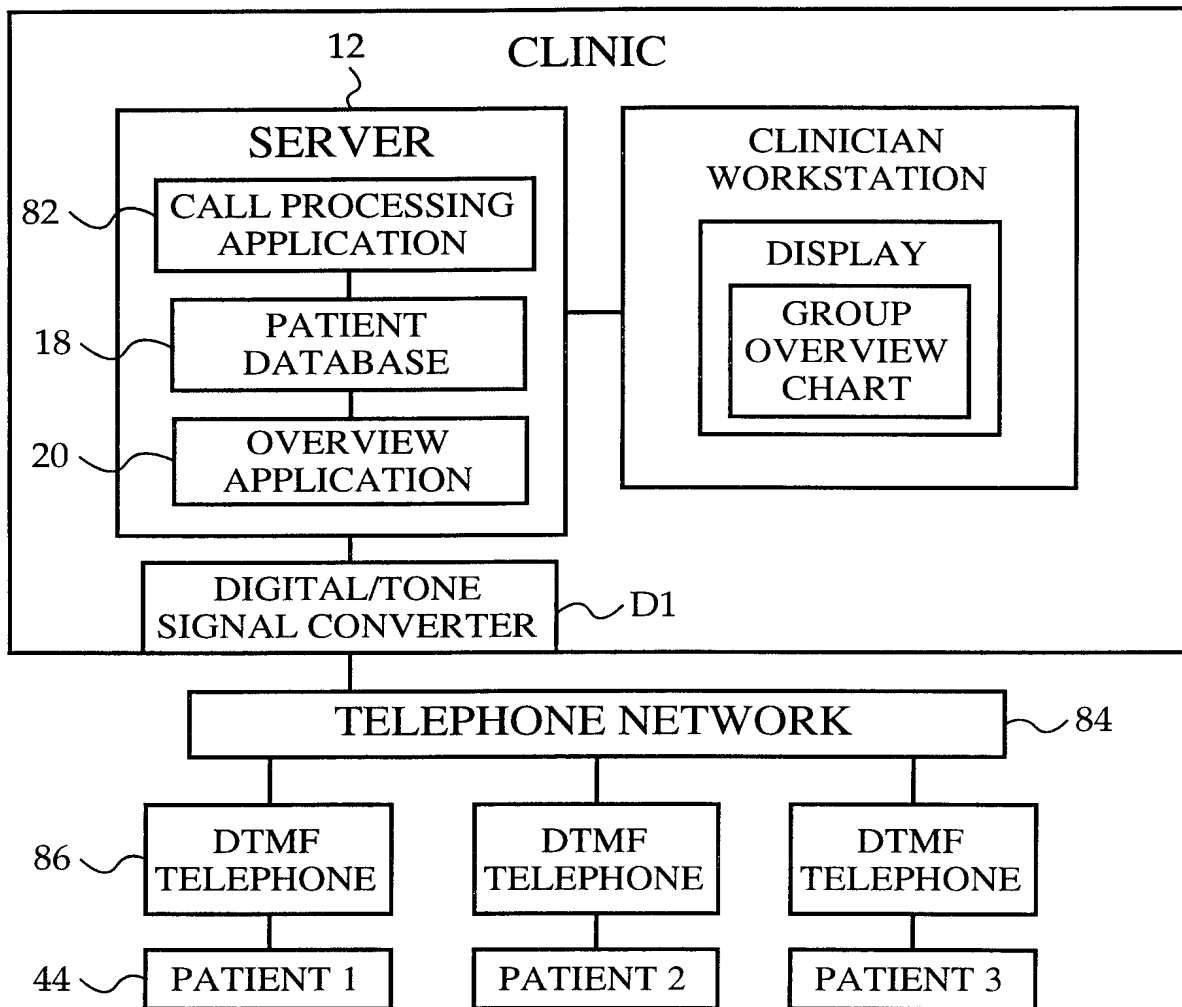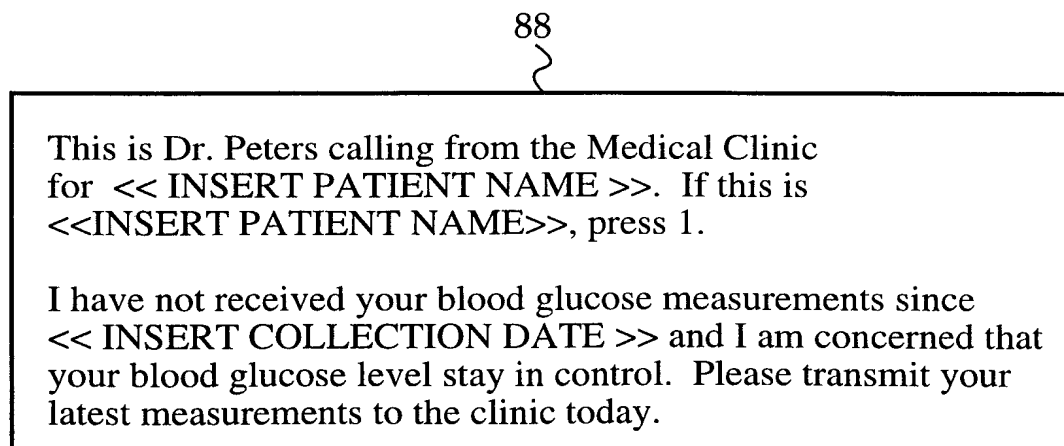
Sincerely,

Dr. Peters

FIG. 5

FIG. 6

CLINIC

12

SERVER

82 — CALL PROCESSING APPLICATION

18 — PATIENT DATABASE

20 — OVERVIEW APPLICATION

CLINICIAN WORKSTATION

DISPLAY

GROUP OVERVIEW CHART

DIGITAL/TONE SIGNAL CONVERTER D1

TELEPHONE NETWORK 84

86 — DTMF TELEPHONE   DTMF TELEPHONE   DTMF TELEPHONE

44 — PATIENT 1   PATIENT 2   PATIENT 3

FIG. 7

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This is Dr. Peters calling from the Medical Clinic
for << INSERT PATIENT NAME >>. If this is
<<INSERT PATIENT NAME>>, press 1.

I have not received your blood glucose measurements since
<< INSERT COLLECTION DATE >> and I am concerned that
your blood glucose level stay in control. Please transmit your
latest measurements to the clinic today.

FIG. 8

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6)   :G06F 159:00
US CL   : 705/2

According to International Patent Classification (IPC) or to both national classification and IPC

B.   FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. :   705/2, 3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C.   DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,549,117 A (TACKLIND et al.) 27 August 1996, column 8, line 6 to column 9, line 13; column 10, line 64 to column 11, line 25.	1-18
A	US 5,331,549 A (CRAWFORD et al.) 19 July 1994, column 2, line 30 to column 3, line 7.	1-18
A	US 4,858,354 A (GETTLER) 22 August 1989, abstract and column 1, line 25 to column 2, line 40.	1-18

☐ Further documents are listed in the continuation of Box C.   ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 FEBRUARY 1998	10 MAR 1998
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer Frantzy Poinvil
Facsimile No. (703) 305-3230	Telephone No. (703) 305-9779

Form PCT/ISA/210 (second sheet)(July 1992)★